The clubhead and hand planes in golf draw and fade shots

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Introduction

Swing planes in golf have become a popular area of research. Cochran and Stobbs (1968) examined the motion of the clubhead and hands qualitatively. Subsequent quantitative analyses have included investigations of the planarity of the whole club (Coleman & Anderson, 2007) and clubhead (Shin, Casebolt, Lambert, Kim, & Kwon, 2008). The aim of this study was to investigate the motion of the clubhead and hands in the downswing quantitatively, and to compare these motions for the fade and draw (as suggested by Coleman and Anderson, 2007).

Method

15 male right handed golfers (20.9 ± 3.2 years, handicap: 2.3 ± 2.1) participated in the study. Golfers were asked to hit 5 successful draw and 5 successful fade shots. Golfers used a choice of 5-Irons (PING, S56) in an indoors laboratory. The resultant shots were quantified using a GC2 launch monitor (Foresight Sports, San Diego, CA) together with nFlight software (PING Inc, Phoenix, AZ). Successful shots were required to finish within 10 yards of the target line, and move 10-25 yards right to left in the air for a draw and 10-25 yards left to right in the air for a fade. Trials were recorded using 8 Raptor-E cameras (Motion Analysis Corporation, Santa Rosa, CA) recording at 460Hz. Three tracking markers on the clubhead were used to reconstruct the path of a virtual marker on the centre of the clubface, which was chosen to represent the motion of the clubhead. A virtual hand marker was defined as the midpoint of tracking markers on the 3rd metacarpal of each hand. The raw coordinates were smoothed using a 4th order Butterworth filter (low pass cutoff 80Hz for the club and 30Hz for the hands) and were then interpolated to 2000Hz to increase the accuracy of locating key time events. The late downswing was defined as running from downswing club shaft horizontal to the end of the downswing. Planes were fitted to the clubhead and hand motions over this period using orthogonal least-squares regression (Willmott & Dapena, 2012). The planes of the club and hands were analysed in relation to the horizontal and also the target line. Data were compared using dependent T-tests.

Results and Discussion

Table 1 summarises the plane orientations of the two types of shots. The late downswing planes for both the clubhead and hand planes pointed significantly further to the left in the fade than in the draw. The hand planes pointed about 9° to the left of the clubhead planes. This latter finding supports Nesbit's (2005) observation of differences between the clubhead and hand planes (9° to 12°), although he did not detail how this angle was calculated. There was a small but significant increase in steepness between the draws and fades for the clubhead plane, but not for the hand plane.

	Draw	Fade	P Value
Clubhead Plane Angle to the Target Line (°)	-3.7 ± 1.6	10.1 ± 2.9	<0.001
Clubhead Plane Angle to the Horizontal (°)	59.4 ± 2.6	60.8 ± 2.5	0.001
Hand Plane Angle to the Target Line (°)	5.3 ± 7.5	19.6 ± 7.67	<0.001
Hand Plane Angle to the Horizontal (°)	57.6 ± 11.3	57.6 ± 11.8	0.943

Table 1: Clubhead and hand kinematics in draw and fade shots. Positive and negative angles denote directions pointing to the left and right, respectively, of the stated target line. Statistical significance set to $P < 0.01$

Figure 1 visualises the clubhead and hand motions relative to the clubhead's late downswing plane, by showing how the residuals changed over the course of the downswing for two participants for the two shots. Positive values indicate that the marker was above the plane, and the scale of the vertical axis has been magnified for clarity.

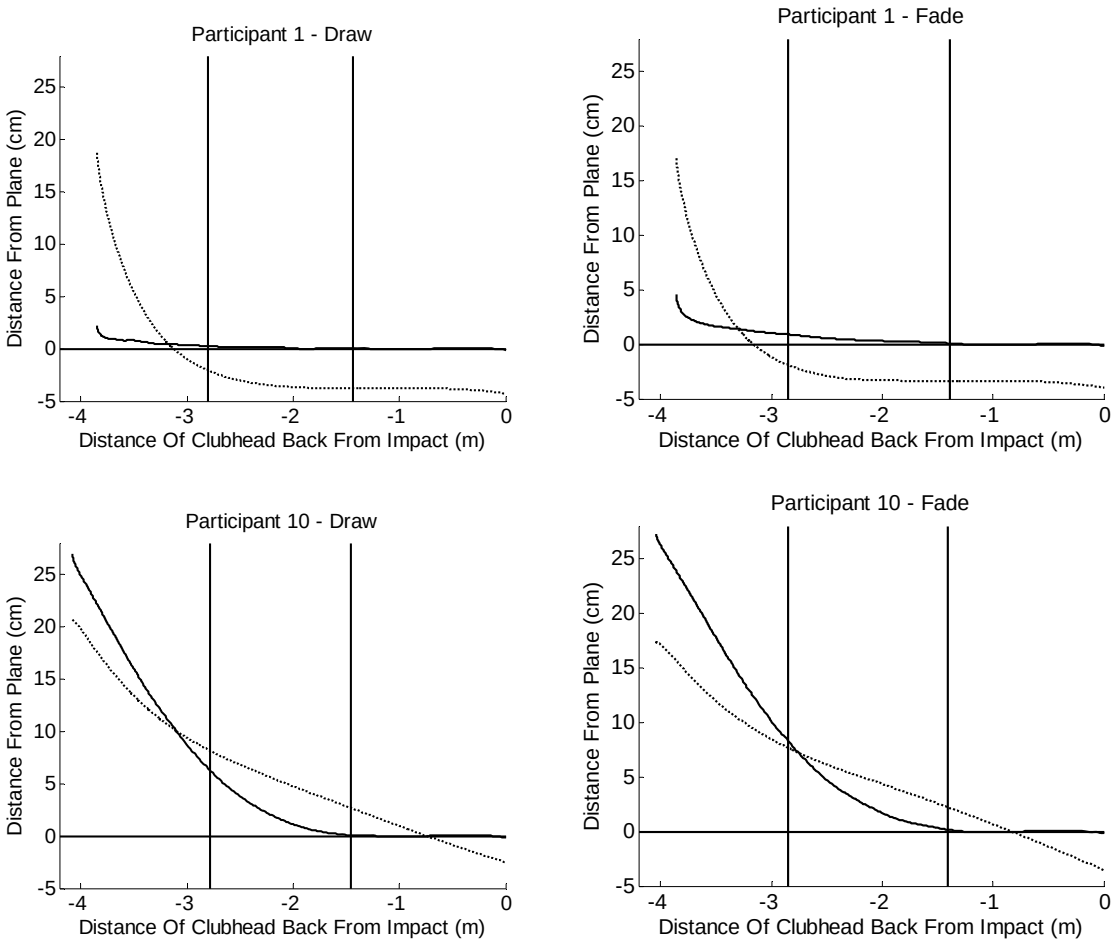

Figure 1. Two examples of the club and hand residuals in the downswing for a sample draw and fade. The solid curve represents the clubhead; the dotted curve represents the hands. The left and right solid vertical lines denote clubshaft vertical and horizontal in the downswing respectively. The solid horizontal line represents the clubhead plane during the late downswing.

For eight golfers the clubhead was further from the plane at the start of the downswing than the hands were, whereas seven golfers started their downswing with their hands further from the clubhead plane. All 15 golfers' hands were below the late downswing clubhead plane at the end of the downswing. This correlates with the movement of the hands to the left of the clubhead plane for both shots at the end of the downswing. The residuals of the clubhead and the hands relative to the late clubhead plane intersected at least once for all golfers during the downswing (as seen in Figure 1), although the timing of this varied between golfers. There were greater differences between golfers in relation to the motion of the clubhead and the hands (as seen in Figure 1) than between the draw and fade.

In conclusion, both the clubhead and hand planes in the late downswing were found to differ significantly in relation to the target line between the draw and fade shots. Greater differences were found between golfers, rather than between shots, in the relationship between the clubhead and hand motion during the downswing. Nevertheless, further detailed analysis is warranted of how the motions around impact – especially the clubface orientation – differ between the two types of shot.

References

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